

DIGITAL EQUIPMENT CORPORATION

STUDENT WORKBOOK \$3.30

education

HUNTINGTON II Simulation Program - USPOP



computers are for kids

digital

EduSystems—expandable, economical

DIGITAL EQUIPMENT CORPORATION
EDUCATIONAL PUBLICATIONS

A partial list of the publications in the continuing series of curriculum material published by Digital for use with EduSystems and RSTS are listed below. Please inquire directly for prices on classroom quantities.

Additional publications may be obtained from:

Software Distribution Center
Digital Equipment Corporation
Maynard, Massachusetts 01754

Population: Self teaching BASIC Workbook	\$2.00
BASIC Matrix Operations, Project Solo	\$1.00
Problems for Computer Mathematics	\$1.25
Advanced Problems for Computer Mathematics	2.00
BASIC Application Programs	
Mathematics I	\$1.00
Mathematics II	1.00
Science	1.00
Business and Social Studies	1.00
Plotting	1.00
Huntington I Application Programs	
MATHEMATICS	\$2.00
TEACHER ASSISTANCE	1.00
Huntington I Simulation Programs	
BIOLOGY	\$1.00
CHEMISTRY	2.00
EARTH SCIENCE	1.00
PHYSICS	2.00
SOCIAL STUDIES	1.00
Huntington II Simulation Modules	
Student Workbook	\$0.30
Teacher's Guide	.30
Resource Handbook	.50
Program Paper Tape	1.00

STUDENT
MANUAL

USPOP

UNITED STATES POPULATION STUDY

Developed By:

James Friedland, General Douglas MacArthur High School
Levittown, New York

Support Material By:

James Friedland

Programmed By:

James Friedland
Stuart Hollander, State University of New York
Stony Brook, New York

HUNTINGTON TWO COMPUTER PROJECT

Copyright © 1973, State University of New York

13 June 1973

The work of the Huntington Two Computer Project is partially
supported by the National Science Foundation, Grant GW-5883.

ATTENTION

MAIL

USPOP

ENTERED STATES POPULATION STUDY

Developed by:

James F. Bland, General Manager, Bland School
Bland, New York

Support Material by:

James F. Bland

Programmed by:

James F. Bland
General Manager, Bland School
Bland, New York

FORNITION TWO COMPUTER SYSTEM

Copyright © 1973, State University of New York

11 June 1973

The work of the Bland School Two Computer System is partially
supported by the National Science Foundation, Grant CW-5683.

USPOP

STUDENT MANUAL

Table of Contents

I. Introduction	1
II. Your Role in <i>USPOP</i>	2
III. Using <i>USPOP</i> 's Computer Program	5
IV. Basic Investigations	9
V. Advanced Investigations	15

REPORT

STUDENT MANUAL

Table of Contents

I. Introduction	1
II. Your Role in USAP	5
III. USAP's Computer Program	2
IV. Basic Investigations	9
V. Advanced Investigations	15

I. INTRODUCTION

When you are studying population change, you are carrying out a study in demography. USPOP allows you to study many aspects of the United States' human demography including population growth, age and sex distribution.

The word demography can be traced back to ancient Greek. *Demos* means people and *graphos* meaning writing or mapping. Demography was one of the first fields in biology to make use of mathematics. It had its origin in census taking and dates back as far as the early Roman Empire. Imperial Rome was interested in the census for at least two reasons. First, they needed census data in order to figure how much tax money should be collected in each area. They also used census data to assure that they would have enough young men to fill their powerful growing armies.

Today many people are interested in demography for additional reasons. In many areas of the world, human populations have reached or are nearing the limits of their resources. Large increases in population in these areas will lead to increased starvation and disease. There are even those in the United States who are concerned that we too will reach the limit of our resources in the near future.

Naturally, government is still interested in census data to calculate taxes and other programs, such as welfare, that deal with numbers of people. Every ten years the United States carries out a nationwide census, and such large amounts of data are collected that it takes several years for it to be analyzed. But in the meantime, the Government has to be able to plan ahead. In between census years, how does the United States know its population size and makeup? How can the United States plan 30 or more years into the future?

Both of these questions bring up another aspect of demography. Demography is also concerned with population projection. U.S. Government demographers must be able to estimate future populations at least 50 years into the future to enable the Government to operate efficiently and anticipate the needs of the citizens.

How do demographers go about making such a projection? The first step is to gather all of the current facts about the population to be studied. Such things as fertility, birth distribution, mortality, age and sex distribution are determined from the latest census data. In addition a series of educated guesses (or assumptions) must be made to predict changes that might happen in the future. Then using mathematical formulas and computers, projections are made on the basis of these facts and assumptions.

For example, using 1960 data, demographers made an assumption that fertility would slowly decrease to 2.5 children for each completed family, while all other factors remained the same. Using the census data and these assumptions, they projected the population for the year 2010.

Such a projection will be useful only if fertility does decrease to 2.5 children per completed family. Because of this, demographers seldom make a single projection. They generally make a series of projections, each based on different assumptions.

USPOP will allow you to make such projections and to investigate the consequences of many different demographic changes.

II. YOUR ROLE IN USPOP

Your teacher will assign you at least one of the *USPOP* student investigations contained in this Manual. Each investigation calls on you to be the demographer. *USPOP*'s program already has all the necessary mathematical formulas and the latest census data. You will have to supply the assumptions that attempt to predict changes that might happen in the future.

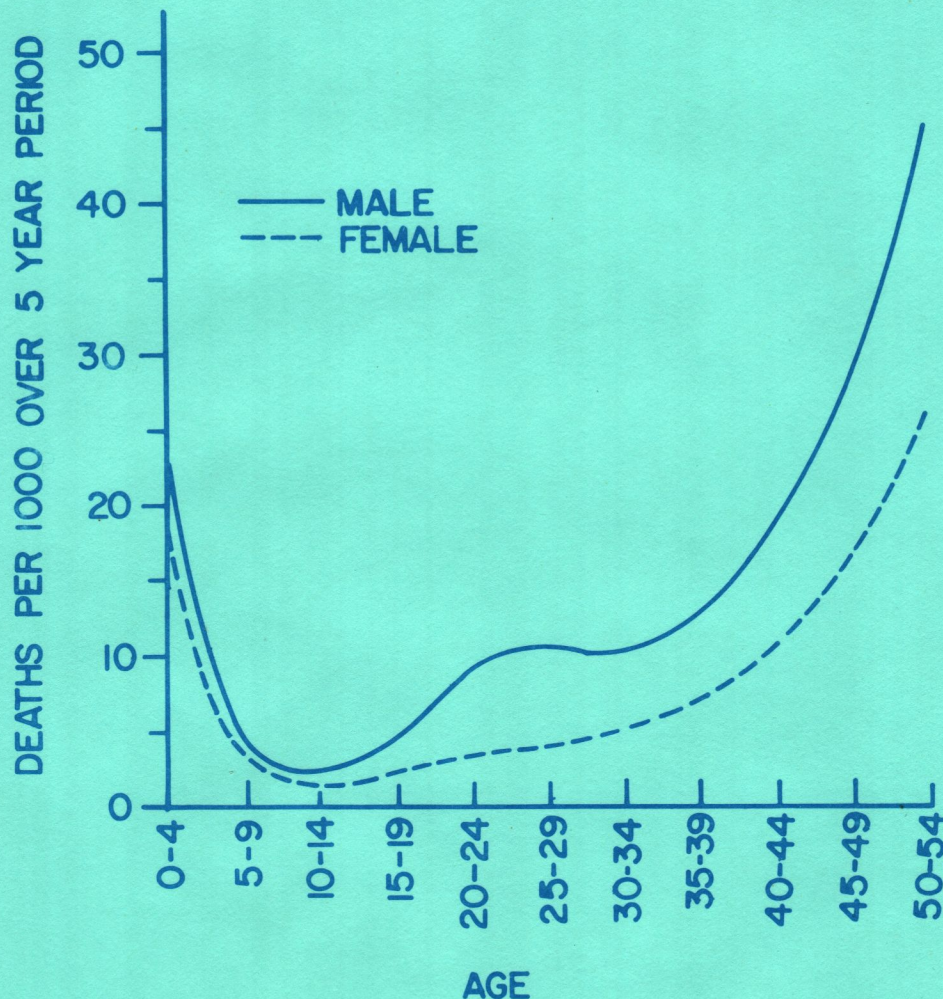
The factors that *USPOP* allows you to study are the following:

- 1) Fertility - the average number of children a woman can be expected to have during her life. Fertility does change from year to year, but usually only by small amounts. In 1966 fertility was equal to 2.7 children per female, and in 1967 it was 2.6 children per female. Over greater periods of time, larger changes occur. (In 1955 the fertility was 3.6 children per female.)
- 2) Birth Distribution - the ages at which females can be expected to have their children. Look at the following table:

<u>Age</u>	<u>Per Cent of Total Fertility 1970</u>
10 - 14	.2
15 - 19	14.3
20 - 24	33.8
25 - 29	28.5
30 - 34	14.7
35 - 39	6.6
40 - 44	1.8
45 and over	.1

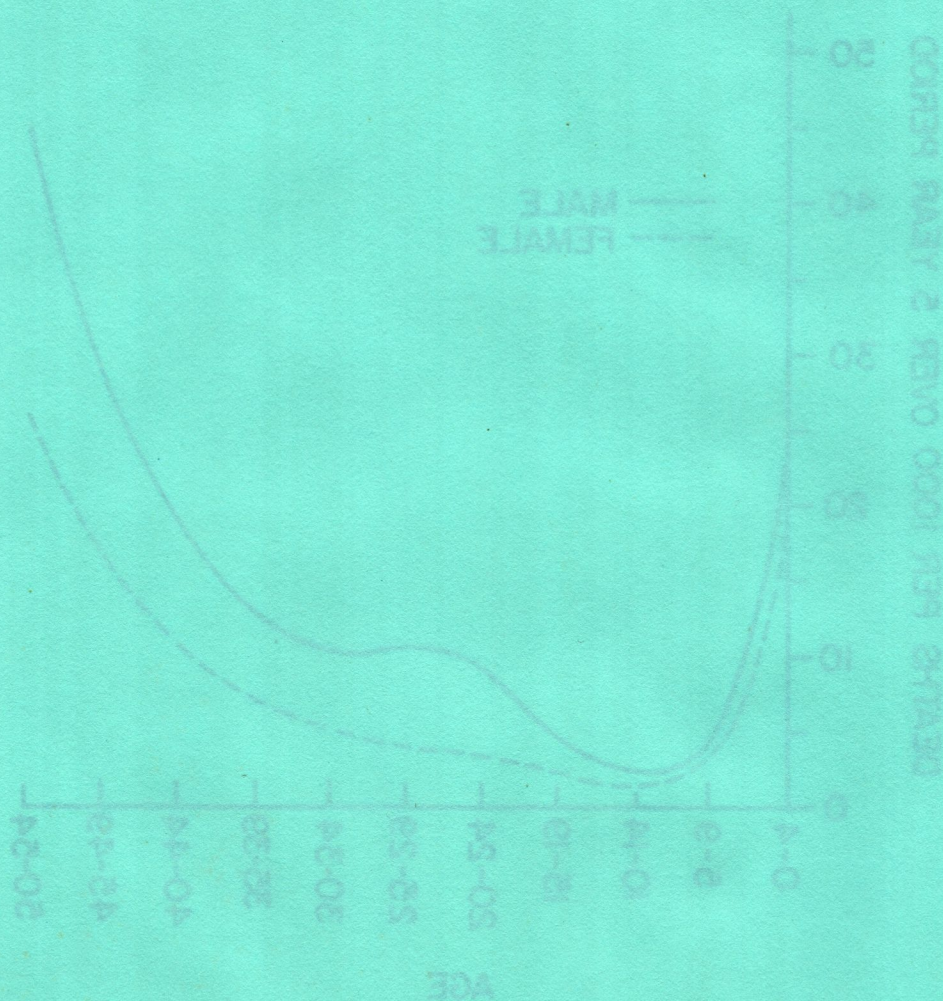
Notice that this birth distribution predicts that women in the age group 20-24 are most likely to have children. Why do you think this might be so?

- 3) Sex Ratio of Offspring - today there are more males born than females. For every 200 live females born, there are 210 male offspring. Thus, only 48.7% of the children born are female. With new controls over reproduction, it may soon be possible to select the sex of your offspring. What do you think this may do to the sex ratio? You can explore this assumption with *USPOP*.
- 4) Mortality Rates - mortality means death. The mortality rates used in *USPOP* predict the chance that a person will die within the next five years. Below is a graph of mortality rates for males and females under 55 years of age.



As you can see, males are always more likely to die than females. Also notice that there is a higher risk of death in the very old and the very young. Does this have to remain this way? *USPOP* allows you to judge the effect of changing mortality.

- 5) *USPOP* also allows you to alter the size of the population. Demographers in general do not alter their populations unless they assume a war or a serious disease. Since these events are usually hard to predict, demographers avoid making projections based on such assumptions. However, *USPOP* will allow you to make and test such assumptions if you wish.



III. USING USPOP'S COMPUTER PROGRAM

USPOP's computer program contains all the mathematical formulas necessary to carry out the assigned projections. It also contains the latest census data.

When you type "RUN", the computer will ask a series of questions in order to determine your assumptions. The computer will first ask:

DO YOU WANT REPORTS 1) EVERY 5 YEAR INTERVAL, OR 2) SELECTED YEARS?

In the beginning, select choice (1).

Next the computer will ask:

YEAR AT START OF PROJECTION?

If you are going to make use of the census data already stored in the program, you should type "1970". If you are basing your projection on data from another year, you should type the appropriate year.

DO YOU ASSUME STANDARD FERTILITY (1=YES, 0=NO)?

If you wish to assume that the fertility in the first year of your project will be equal to that in 1970, type "1" (for YES). If not, type "0" (for NO).

WILL FERTILITY (1) REMAIN CONSTANT OR (2) CHANGE SLOWLY TO A NEW LEVEL?

Select the number that best represents your assumption as to what will happen to fertility in the future.

DO YOU ASSUME STANDARD BIRTH DISTRIBUTION (1=YES, 0=NO)?

If you assume that the birth distribution will remain close to 1970 levels, then you should type "1" (for YES). If you assume that the birth distribution will change, type "0", and the computer will ask you to type in the new distribution you assume.

DO YOU ASSUME STANDARD SEX RATIO (1=YES, 0=NO)?

If you assume that the sex ratio in your projection is equal to that in 1970, then type "1". If not, type "0".

DO YOU ASSUME STANDARD MORTALITY (1=YES, 0=NO)?

If you assume that the mortality rates in your projections are the same as the 1970 figures, then type "1". If you think that mortality will be different, type "0". If you type "0", you will be allowed to change any or all of the mortality rates.

DO YOU ASSUME STANDARD POPULATION (1=YES, 0=NO)?

Type "1" if you assume that the population at the start of your projection is equal to that in the 1970 census. If you type "0", you will be allowed to change any or all of the population groups.

When you have answered all of the above questions, the computer will be ready to make a projection of the population based on your assumptions. It will then ask:

REPORT: 1) SHORT 2) LONG 3) GRAPH 4) CHANGE ASSUMPTIONS 5) END?

If you select (1), you will receive a report similar to the one below. It gives year, total population and birth rate. It has the advantage of being fast.

YEAR 1970

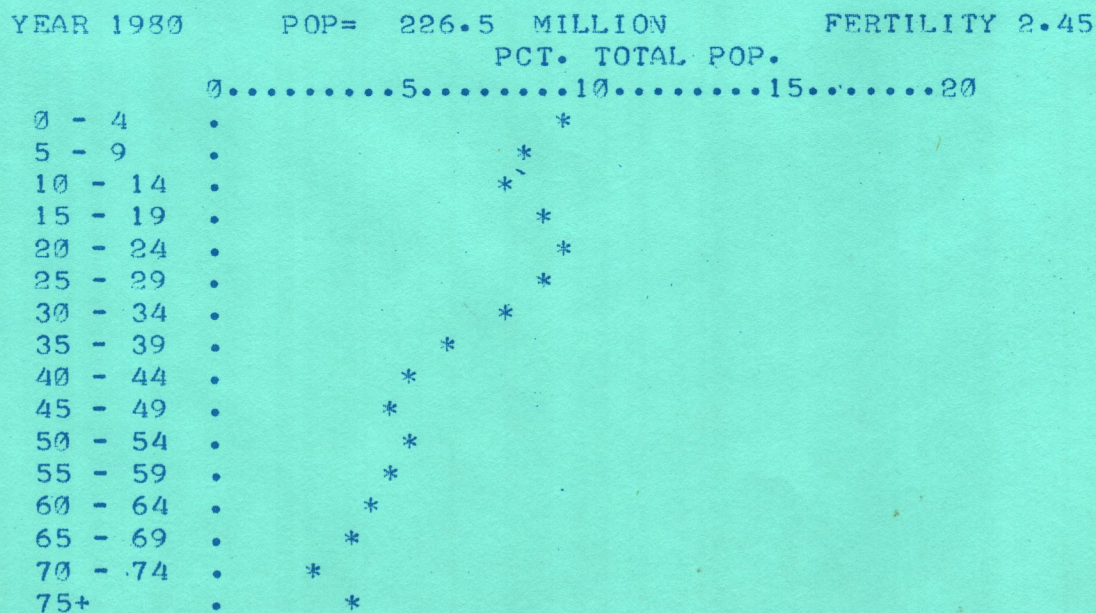
POP. 204.8 MILLION

FERTILITY 2.45

If you select (2), you will get all the information offered by (1), and in addition get a population breakdown by age and sex, similar to the report shown on the next page.

YEAR 1975	POP= 214.5 MILLION		FERTILITY 2.45
AGES	FEMALES <-MILLIONS->	MALES	PCT. TOTAL
0 - 4	8.9	9.4	8.5
5 - 9	8.5	8.8	8
10 - 14	9.8	10.2	9.3
15 - 19	10.3	10.6	9.7
20 - 24	9.5	9.8	9
25 - 29	8.6	8.6	8
30 - 34	7	6.8	6.4
35 - 39	5.8	5.6	5.3
40 - 44	5.6	5.4	5.1
45 - 49	6	5.6	5.4
50 - 54	6.1	5.6	5.5
55 - 59	5.5	4.9	4.9
60 - 64	4.9	4.2	4.3
65 - 69	4.2	3.4	3.5
70 - 74	3.3	2.3	2.6
75 AND OVER	4.6	3.1	3.6

If you select (3), you will get all of (1), plus a graph showing age distribution in the population similar to the following:



Option (4) allows you to change any of your assumptions and then continue your projection; (5) allows you to end the projection.

You may have noticed that *USPOP* allows you to test a very large number of different assumptions about future population growth. For this reason it is very important to plan before going to the computer.

To aid in your planning, we have included EXPERIMENT PLAN SHEETS at the back of this Manual for planning your responses to the computer's questions.

IV. BASIC INVESTIGATIONS

INVESTIGATION #1

WHAT EFFECT WILL CHANGES IN FERTILITY HAVE ON POPULATION BY THE YEAR 2000?

The year 2000 is less than 30 years away. If you study the table below, you will notice that fertility has varied greatly in the last 30 years. How might it change in the next 30?

<u>Year</u>	<u>Fertility (children per female)</u>
1940	2.3
1945	2.5
1950	3.1
1955	3.6
1960	3.7
1965	2.9
1970	2.45
1972	2.1 estimated

The 1970 census revealed a low of 2.45 children per female, and recently even lower figures have been estimated. Some demographers see this dip as permanent, while others say that this drop in fertility is only temporary, reflecting recent economic uncertainty.

Your objective, as the demographer, is to produce a set of assumptions that you think may hold for the next 30 years, and then to evaluate what effect change in fertility will have on the population in the year 2000.

USPOP allows you to control up to five factors at a single time. But in a controlled experiment we try to change only one variable at a time.

Suggested Procedure

- 1) Select from four to eight possible fertility figures (one should be equal to the 1970 fertility). Consult the table above for help in picking realistic values.
- 2) Record these fertility assumptions on an EXPERIMENT PLAN SHEET (found at the back of this Manual). Each fertility assumption should be entered for different projections.

- 3) Complete the remainder of the EXPERIMENT PLAN SHEET, keeping all other factors uniform from projection to projection. (If you elect to use standard values, the computer program will automatically input 1970 figures for you.)
- 4) Run each of your projections separately up to the year 2000. The short report form (Report #1) will be satisfactory.
- 5) Construct either a table or a graph that summarizes your findings. If you use a graph, you can plot population on the y-axis versus years on the x-axis. To make the graph easier to read, use a different color for each of your projections.
- 6) Using your results, answer the follow-up questions.

Follow-up Questions

- 1) If fertility of women in the United States stays near the 1970 level of 2.45 children per female, how many additional people will there be by the year 2000?
- 2) New York City has a population of approximately 7 million people. How many New York-sized cities will have to be built to accommodate this increased population?
- 3) If fertility were to remain low (from 2 to 2.3), would the problem of extra population be as pressing? What in your results indicates this?
- 4) If fertility were to rise to levels seen in the middle fifties, approximately how many additional people could be expected by the year 2000 as compared to the current U. S. population?
- 5) What relationship exists between fertility and population growth?

INVESTIGATION #2

WHAT EFFECT WOULD DELAYING THE BIRTH OF THE FIRST CHILD HAVE ON POPULATION GROWTH?

As you should be able to see from the table below, the most likely time for a birth in a female's life is between the ages of 20 and 24. This is the time that most women have their first child. Of course, some women have their first child earlier and some later, and this too is indicated by the birth-distribution figures below:

<u>Age</u>	<u>Per Cent of Total Fertility in 1970</u>
10 - 14	.2
15 - 19	14.3
20 - 24	33.8
25 - 29	28.5
30 - 34	14.7
35 - 39	6.6
40 - 44	1.8
45 - 49	.1

Having the first child in the early twenties seems natural in the United States, but there are countries throughout the world where this would not be true. In countries such as India, large numbers of females marry in their early teens and have a child long before they are twenty. There are countries such as Ireland, where marriage has traditionally not taken place until the late twenties and therefore children are born later in life than here in the United States.

Would a change in birth distribution alter our population's growth rate? You, as a demographer, are assigned to investigate this question. You must test a series of assumptions using differing birth rates. You should compare our current distribution to distributions with the births occurring earlier and later.

Suggested Procedure

- 1) Using the EXPERIMENT PLAN SHEETS found at the end of this Manual, design from three to eight sets of inputs that differ only in their birth distribution. (One should be equal to the standard 1970 levels.) Notice that the sum of the percentages should always equal 100%.

- 2) Run each of your projections separately up to the year 2030. For this experiment the short report will be satisfactory.
- 3) Collect and organize your data. Graph population size versus years for each of your projections.
- 4) Answer the follow-up questions based on your results.

Follow-up Questions

- 1) If no change occurred in the birth distribution, what would be the expected population in the year 2030?
- 2) Do you feel that lowering the age at which most women have their first child would have much of an effect on the population? What in your data supports your view?
- 3) Would it be worthwhile for groups interested in population limitation to encourage women to have their children at a later age? Why?
- 4) Could having children at a younger age be related to any of the other variables such as fertility, mortality, sex ratio, etc.?*
- 5) Is there any general rule you can formulate to relate birth distribution and population growth? Is this rule shown in your graph?

*NOTE - USPOP's model assumes that age distribution of mothers is not related to any other variable. This may not be realistic, however.

INVESTIGATION #3

WILL CHANGES IN INFANT MORTALITY AFFECT FUTURE POPULATION LEVELS?

Infant mortality is embarrassingly high in the United States as compared with other advanced countries. As noted in the August 1971 issue of *SCIENTIFIC AMERICAN*, pg. 4, the United States ranks 14th among nations with regard to infant mortality.

Currently, the mortality rate for those less than one year old is about 22 deaths per 1000. If the United States decides to make a major effort to reduce infant mortality, what is a realistic goal? The article suggests that a rate of 17.4 deaths per 1000 may be the "minimum attainable mortality rate." This represents a reduction of 22%.

However, it may not prove possible to attain this low figure for all segments of the population. For this reason, as a demographer, you will want to produce a series of projections with varying assumptions.

NOTE: USPOP considers all children of less than 5 years as a single group. The mortality rate for the group, ages 0 to 4, is now 17.8 per 1000 for females and 22.4 per 1000 for males. We will assume, for this investigation, that if you change infant mortality, the mortality of the entire group is also changed by an equivalent amount.

Suggested Procedure

- 1) Use 1970 mortality rates as a comparison. In addition, select four to eight other changes in infant mortality.
- 2) Enter your different assumptions onto the EXPERIMENT PLAN SHEET found at the back of this Manual. Keep all other factors constant from projection to projection.
- 3) Run each projection separately up to the year 2020. Report #1 should be satisfactory, but for more information on births, select Report Form #2 (if time permits).

4) Organize your results. Below are some possible methods:

- a) Make a table showing change in infant mortality and population in the year 2020.
- b) Make a single graph showing population versus years. Each projection should be shown in a different color or pattern. (Make sure to include a key identifying each line.)
- c) Make a graph showing population in the year 2020 versus change in infant mortality.

5) Answer follow-up questions.

Follow-up Questions

- 1) If a drop in infant mortality occurs, will it have a major impact on future population levels in the United States? What data do you have to support this conclusion?
- 2) Is the effect of lowering infant mortality more important or less important, as time goes on, in affecting total population size?
- 3) It has been said, "Those children who might have died due to high infant mortality now live long enough to have children of their own." Do you see any proof for this statement? If so, indicate what in your results backs up this statement; if not, indicate how your data shows this is not an important factor.

V. ADVANCED INVESTIGATIONS

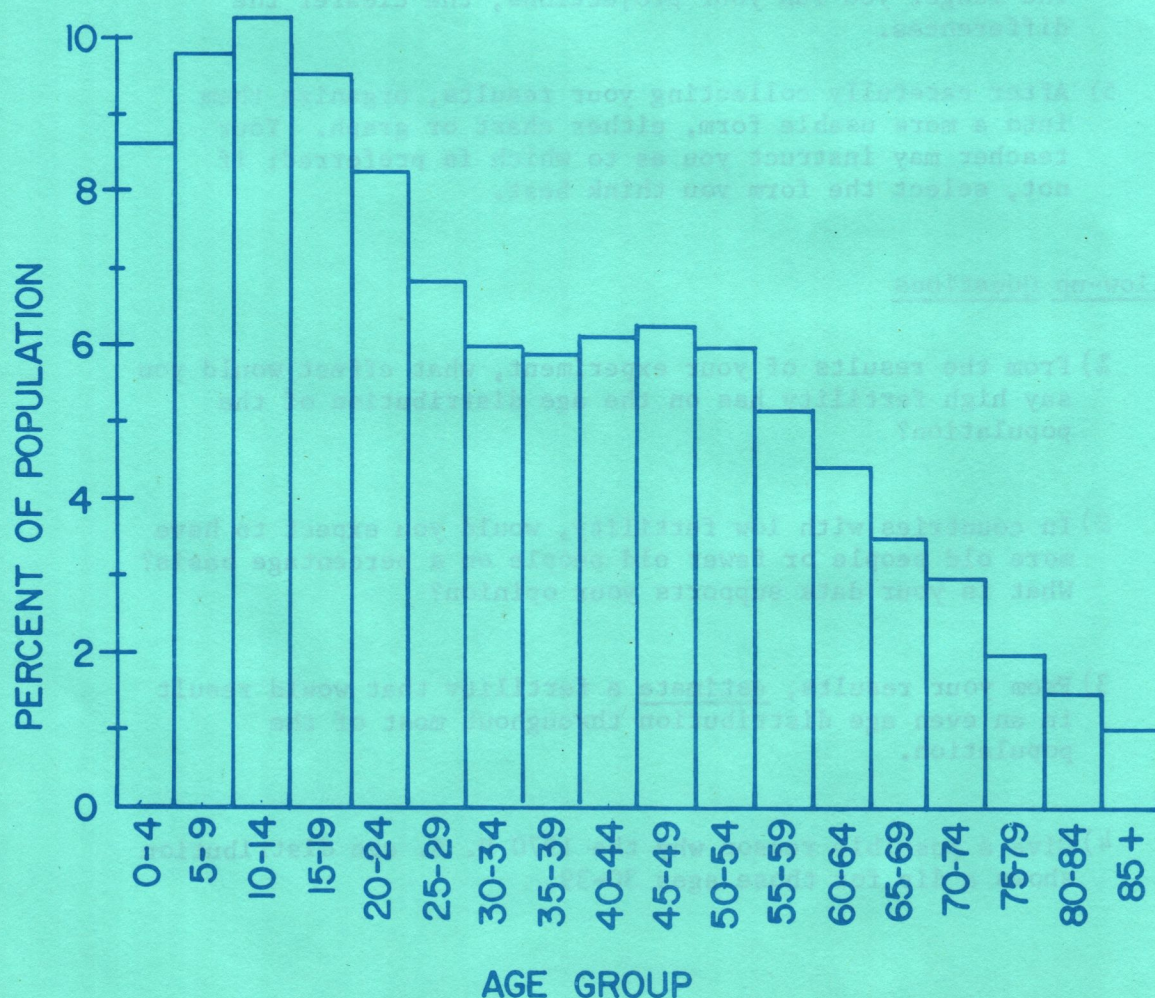
INVESTIGATION #4

HOW DOES FERTILITY AFFECT THE AGE DISTRIBUTION OF THE POPULATION?

The median age in the United States today is about 28 years. This means that over half the population is younger than 30. In addition, approximately 34% of the population is under 18. Why do we have such a large proportion of young people in our population?

It seems obvious that both fertility and mortality should play an important role: if, for example, many people die in middle or old age, then a majority of those living should be young; if women have many children, then the children should outnumber the parents; in either case, the majority of the population should be young. In this experiment you will investigate the role fertility plays in determining the age distribution of the population. In Investigation #5, mortality will be investigated.

Our current population distribution is given on the graph below:



Suggested Procedure

You are investigating the effect fertility has on age distribution. To answer this question, you should design a set of inputs reflecting your assumptions:

- 1) Select from four to eight different, wide-ranging values for fertility. (1970 fertility was equal to 2.45 children per female.) Using an EXPERIMENT PLAN SHEET (found at the end of this Manual), write in a different fertility for each projection.
- 2) Complete the list of inputs for each projection, keeping all factors other than fertility constant.
- 3) Since we are investigating the effect of fertility on age distribution, you should select Report Form (2) or (3). Report Form (2) gives you age-distribution data in chart form, while Report Form (3) gives the age-distribution information in graphical form.
- 4) Run each of your projections to at least the year 2030. The longer you run your projections, the clearer the differences.
- 5) After carefully collecting your results, organize them into a more usable form, either chart or graph. Your teacher may instruct you as to which is preferred; if not, select the form you think best.

Follow-up Questions

- 1) From the results of your experiment, what effect would you say high fertility has on the age distribution of the population?
- 2) In countries with low fertility, would you expect to have more old people or fewer old people on a percentage basis? What in your data supports your opinion?
- 3) From your results, estimate a fertility that would result in an even age distribution throughout most of the population.
- 4) Give a possible reason why the 1970 U. S. age distribution shows a dip for those ages 30-39.

The chart below shows 5-year mortality rates determined in 1970
(number of deaths per 1000 over 5-year period).

<u>Terminal Age</u>	<u>Male</u>	<u>Female</u>
Years	Deaths per 1000	
0 - 4	22.5	17.8
5 - 9	3.5	2.8
10 - 14	2.2	1.5
15 - 19	4.9	2.2
20 - 24	9.6	3.4
25 - 29	10.5	4.0
30 - 34	10.3	5.2
35 - 39	12.9	7.4
40 - 44	19.0	11.1
45 - 49	29.3	16.7
50 - 54	45.1	25.8
55 - 59	69.1	35.8
60 - 64	106.9	51.4
65 - 69	156.5	78.9
70 - 74	220.7	121.4
75 and older	409.3	337.3

INVESTIGATION #5

EFFECT OF MORTALITY RATE ON AGE DISTRIBUTION IN THE POPULATION.

If you have not already done so, read the introduction to Investigation #4.

In this investigation, we will assume that the fertility remains constant and vary the mortality rates of the population to determine their effect on the age distribution.

There are many ways in which we might change mortality rates; for example, we might lower mortality for the young, or lower it for the old, or both. In this experiment we will assume that all ages will be affected evenly. If you want to investigate other possibilities, you should first speak to your instructor.

Suggested Procedure

You are to design an experiment in which you vary the mortality in order to evaluate the effect of different mortality rates on age distribution.

- 1) Select four to eight different sets of mortality rates. If you elect to use the standard rates as one of your sets, the computer will automatically input the 1970 mortality rates.
- 2) Enter each set of mortality figures into a different column on the EXPERIMENT PLAN SHEET (at the back of this Manual). For clearer results, select mortality rates that vary over a wide range.
- 3) Complete the rest of the sheet, keeping all other variables constant from projection to projection.
- 4) Select either Report Form (2) or (3), since they both give information on age distribution.
- 5) Run each of your projections for at least 50 years, or until you have clear results.
- 6) After completing all your projections, collect and organize your data into either a graph or table. If your teacher does not give you specific instructions, choose the form you think best.

Follow-up Questions

- 1) If there were a drastic increase in mortality in the future caused, say, by massive air pollution, would the age distribution be affected? If so, in what way?
- 2) If all ages had a lower mortality, which age group would show the greatest percentage increase? How do your results indicate this?
- 3) If current mortality conditions continued for the next 50 years, would the young (less than 30) still dominate the population?
- 4) If all mortality rates were to decrease substantially, what impact would that have on this country?

Further Investigation Suggestions

Investigate the role of sex ratio on both population number and age distribution.

Investigate possible reasons for the current U. S. age distribution.

See *USPOP RESOURCE MANUAL* for additional projects and ideas.

PROJECTION NUMBER	1	2	3	4	5	6	7	8
MORTALITY 1=STANDARD (1970) Ø=CHANGED								
IF ANSWER Ø DEATHS PER 1000 IN AGES: 0 - 4	F	M	F	M	F	M	F	M
5 - 9								
10 - 14								
15 - 19								
20 - 24								
25 - 29								
30 - 34								
35 - 39								
40 - 44								
45 - 49								
50 - 54								
55 - 59								
60 - 64								
65 - 69								
70 - 74								
75 & older								
POPULATION 1=STANDARD (1970) Ø=CHANGED*								
REPORT: 1=SHORT REPORT 2=LONG REPORT 3=AGE DISTRIBUTION GRAPH 4=CHANGE ASSUMPTIONS 5=END	THIS QUESTION WILL BE REPEATED THROUGHOUT RUN							

*If population changed, use chart similar to that in mortality section.



